

INDELIBLE WATERMARK ON OPTICAL DISCS

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This application claims the benefit of  
provisional patent application No. 60/258,462, filed on  
5 December 27, 2000, which is hereby incorporated by  
reference in its entirety.

Background of the Invention

This invention relates to information-  
recording media in the form of light-readable disks,  
10 and more particularly to providing indelible marking on  
such information-recording media for identification and  
verification of authenticity.

Light-readable information-bearing disks are  
well known, as disclosed in Kramer U.S. patent No.  
15 5,068,846, Mecca U.S. patent No. 5,995,481, and  
Marquardt U.S. patent No. 5,729,533. Commercially  
available digital video discs ("DVDs"), compact discs  
("CDs"), and compact disc read-only memories ("CD-  
ROMs") exemplify recording media of this general type.

20 Light-readable information-bearing disks  
typically comprise a transparent plastic disk-shaped  
substrate, one surface of which comprises sequences of  
depressions ("pits") and intermediate areas ("lands").  
These pits and lands are arranged in accordance with  
25 the information intended to be read by means of optical  
radiation. The patterned side of the plastic substrate

may be covered with a reflective coating, conforming to the local changes in the surface. Light (typically laser light) directed toward the pattern is reflected differently depending on whether the light strikes a high or a low spot. In this way, the light reads the information recorded by the pattern of pits and lands. This information can be processed and played back.

The manufacturing of optical disks is also well known in the art. Conventionally, the process begins with cleaning and polishing one surface of a glass plate. The surface is then covered with a uniform thin layer of photoresistive material. After the photoresistive material is cured, a pattern representing digital data is recorded in the photoresistive layer using a modulated high-energy laser beam. The pattern is subsequently developed and the extra material is removed, leaving a photoresistive coating on the surface of the glass, which comprises a pattern of pits and lands representing the digital data.

Next, the photoresistive coating on the glass plate is covered with a nickel layer, thus creating a "master." The master is electroplated with nickel to provide a mating form, referred to as a "father." The father is also plated with nickel to build a negative image in the form of the original master, referred to as a "mother." The mother disk is then used to form "production stampers" for molding the optical disks.

One process of injection molding of optical disks is described in application No. 09/751,646 (Pickutoski et al.), which is hereby incorporated by reference. According to the method described in this application, polycarbonate plastic material is injection molded against a production stamper and, when

removed from the injection molding machine, has the shape of a substrate having on one surface pits and lands in the pattern representing the digital data.

With the widespread use of light-readable information-bearing disks, disc manufacturers have been increasingly concerned about counterfeit discs. To address this concern, various complicated security systems have been developed. (E.g., Warren et al. U.S. patent No. 5,719,937 and EP 0 671 730 A1).

In the past, marks have been applied to light-readable information-bearing discs through the use of production stampers having the topological features representing graphical or other images on the same side of the stampers as the pits and lands representing digital data. (Kodaka et al. U.S. patent No. 5,346,654, Abraham U.S. patent No. 5,452,282, Bahns U.S. patent No. 5,946,286, and Shin et al. U.S. patent No. 5,398,231). The prior art methods are complicated, time-consuming, and require the use of expensive equipment, such as laser beam recorders. Accordingly, it is desirable to provide simple cost-effective solutions for marking discs, so that authentic discs would be readily distinguishable from counterfeit discs.

In view of the foregoing, it is an object of this invention to provide indelible marks on information-recording media for identification and verification of authenticity of such media.

#### Summary of the Invention

These and other objects are accomplished in accordance with the principles of the invention by providing methods for manufacturing light-readable information-recording media, wherein the back of a

production stamper is laser-scribed, etched, or marked by other means. The marked production stamper is then used to form a substantially transparent substrate having information recorded on it in the form of pits and lands. The formation of the substrate may be accomplished by a standard replication process. During the replication, the mark is transferred from the back of the stamper to the surface of the substrate, thus creating an indelible watermark.

The resulting watermark is visible under normal light conditions and may be machine readable. Also, because the image is molded into the optical media, it is irreversible and permanent. This watermark image, for example, may comprise the manufacturer's logo or any other indicia that uniquely identify the disc, thereby distinguishing it from any counterfeit discs.

#### Brief Description of the Drawings

FIG. 1 is a simplified partial and enlarged cross-sectional view of an illustrative structure used in accordance with the principles of this invention.

FIG. 2 is a top view of an illustrative light-readable information-bearing disc in accordance with the principles of this invention.

#### Detailed Description of the Preferred Embodiments

The present invention may be used with typical manufacturing equipment for the production of optical discs by the stamper-injection molding process or a variation thereof.

FIG. 1 shows a simplified partial cross-sectional view of a typical injection mold, which includes a cavity 30, a top plate 40, a stamper 10, and

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spirit of the invention. For example, the present invention is also suitable for use in systems using injection-compression molding or compression molding.

Dimensions of the mark, which is laser-scribed, etched, or deposited on a stamper, are chosen so that the mark is effectively transferred to and is visible on the resulting light-readable information-carrying media without disrupting the play-back of information recorded by means of pits and lands.

Those of ordinary skill in the art may vary the dimensions of markings on the back of a production stamper depending on system parameters, such as the material and thickness of the stamper, the pressure in the mold cavity, and the desired dimensions of the resulting watermark. If the mark is applied to the production stamper using a laser-scriber, the dimensions of the mark can be varied by changing the power of the laser.

The watermark image may be placed anywhere on the optical disc. For example, the watermark may either be superimposed onto the digital data recorded by means of pits and lands or be formed on the periphery of the data-containing region. In the first case, the watermark will not affect playability, if the surface variations due to the presence of the watermark do not exceed the depth of focus of the system used to read the data. On the other hand, if the mark is large enough to cause disruption of play-back, the lost data can be reconstructed by error-correction. When the watermark is formed on the periphery of the information-containing region, the constraints on the dimensions of the watermark are less strict. In this case, however, the area available for the placement of the watermark is smaller.

The transferred watermark image on disc replicas is visible under normal light conditions, so that authentic discs can be readily distinguished from counterfeit discs. Such watermarks may be designed to  
5 be machine-readable. Also, because the image is molded into the optical media, it is irreversible and permanent. Further, since only the back of the metal stamper needs to be marked for the image to be reproduced in all discs manufactured using this  
10 stamper, the solution in accordance with the principles of this invention provides a cost-effective way of marking a number of discs.

One skilled in the art will appreciate that this invention can be practiced using other than the  
15 described embodiments, which are presented for purposes of illustration and not of limitation. This invention is therefore limited only by the claims which follow.

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